U.S. DEPARTMENT OF COMMERCE
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INSTALLATION, OPERATION, AND MAINTENANCE OF MODELS NO. LF-1 AND LF-2 ORGANICS SAMPLERS FOR WATER

FEDERAL WATER POLLUTION CONTROL
ADMINISTRATION, WASHINGTON, D. C.

DECEMBER 1967

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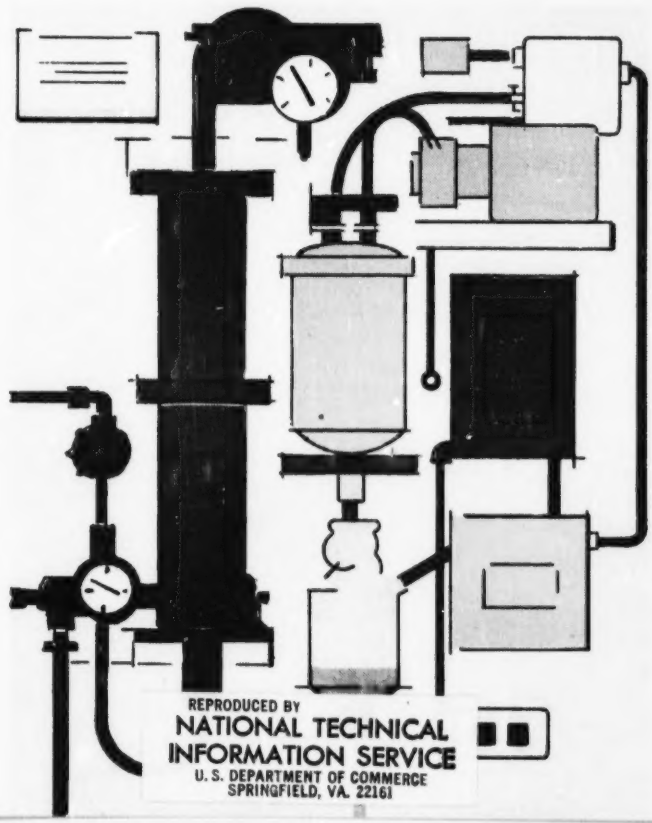
INSTALLATION OPERATION MAINTENANCE

MODELS NO. LF-1 AND LF-2 ORGANICS SAMPLERS FOR WATER

U. S. DEPARTMENT OF THE INTERIOR
Federal Water Pollution Control Administration



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Equipment using the carbon adsorption method for sampling organics carried by raw waters has been redesigned for low-flow-rate operation. Instructions for installation, calibration, operation, use of carbon column data sheet, and shipping of the two organic samplers for water are provided.

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INSTALLATION, OPERATION, AND MAINTENANCE
of
Models No. LF-1 and LF-2
Organics Samplers for Water

U.S. DEPARTMENT OF THE INTERIOR
Federal Water Pollution Control Administration
Division of Pollution Surveillance
Engineering and Field Operations

Revised December 1967

This information has been prepared as a guide for the use of low-flow-rate organics sampling equipment in the FWPCA Water Pollution Surveillance System. Questions or suggestions regarding this material should be directed to the Division of Pollution Surveillance, 1014 Broadway, Cincinnati, Ohio 45202.

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GENERAL

Equipment using the carbon adsorption method for sampling organics carried by raw waters has been redesigned for low-flow-rate operation. These changes in equipment provide greater efficiency of recovery of organics than was previously possible.

Raw water is passed directly through an "all fine" carbon column at the rate of approximately 120 milliliters per minute for a 1-week sampling period. The flow rate is regulated by a metering pump on the downstream end of the carbon column, and the water passed through is automatically measured volumetrically in 1-liter increments and registered on a digital counter.

Because the metering pump is pressure-sensitive, a means of regulating the pressure on that component is provided with both models of the sampler. Model LF-1 (Figure 1) employs a pressure relief valve, and Model LF-2 (Figure 2) uses a constant-head tank for pressure regulation.

Since a 1-week sampling run involves only about 1,200 liters of water, a 1-gpm flow control valve is used to assure fresh water at the sampler at all times. Water that does not pass through the carbon column is bypassed and returned to the river. Model LF-2 operates in such a way that no water need be bypassed if a constantly fresh supply is available at the sampler or if the use of 1 gpm of water would overtax the supply.

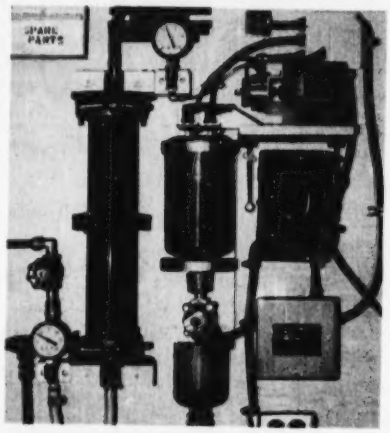


Figure 1. Model LF-1 organics sampler for water.

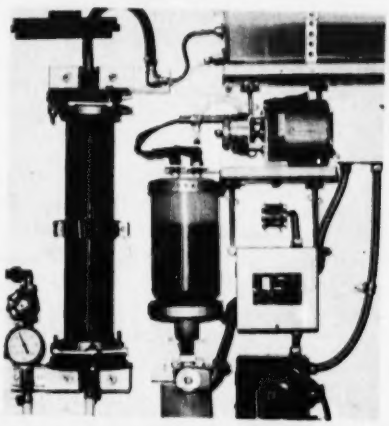


Figure 2. Model LF-2 organics sampler for water.

Both Models LF-1 and LF-2 are mounted on panels 36 inches high and 30 inches wide and are shipped in a crate about 8 inches deep. The approximate shipping weight of a complete unit is 75 pounds.

Operation of the equipment requires a 115-volt, single-phase, 60-cycle electrical supply. Two circuits are controlled by a two-pole, single-throw disconnect switch. All electrical components of the panel operate from one circuit fused for 15 amp. The second circuit is a duplex outlet with ASA grounding-type sockets for use with auxiliary equipment and is also fused for 15 amp.

No shelter is specifically built for remote installation of either model; however, either could easily be installed in a shelter similar to that of the H_2O-M2C organics sampler or in a small prefabricated metal building.

Specially built explosion-proof equipment, designated LF-2-EP, operates in the same manner as the Model LF-2 sampler.

Schematic diagrams of Models LF-1 and LF-2 are shown in Figures 3A and 3B.

In most cases, settling of the raw water before it passes through the carbon column is unnecessary and undesirable. Where waters with turbidity of more than 2,000 Jackson candle units are frequently encountered, some of the suspended material may have to be settled out before the water passes through the carbon column.

INSTALLATION

Organics samplers may be installed in various locations, but the installations are of two general types, water plant installations and field installations. Although the arrangement of plumbing fixtures may vary widely with conditions at the site, in general it will resemble the schematic diagram shown in Figure 4A for water plant installations and Figure 4B for field installations where water must be pumped to the sampler.

For field installations, the equipment must be protected against freezing weather. The shelter housing the equipment should be insulated, and a thermostatically controlled, fan-type electric heater should be provided in the equipment shelter. Heating cable for protection of the intake lines may also be necessary. The wiring circuits of the equipment panel are not sufficient for operation of all accessory equipment required for field installations; therefore, additional outlets must be provided in the equipment shelter.

All installations of organics sampling equipment require attention to certain details in order to achieve the best possible results. Since the purpose of the carbon adsorption column (CAC) is to adsorb small amounts of organic impurities from the water and obtain the largest

LEGEND

A — 3/8-in. globe valve
B — 1-gpm flow control valve
C — Pressure relief valve
D — Pressure gauge (0-15 psi)
E — "All fine" carbon column
F — Pressure gauge (0-15 psi)
G — Metering pump
H — Volumetric measurement tank
I — Solenoid valve
J — Liquid level control relay
K — Disconnect switch
L — Convenience outlet
M — Digital counter

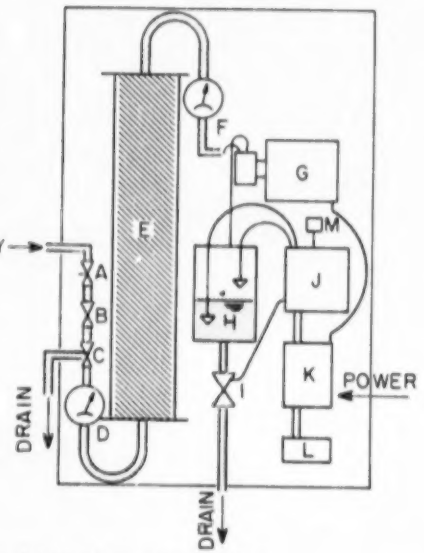


Figure 3A. Schematic, Model LF-1 organics sampler.

LEGEND

A — 3/8-in. globe valve
B — 1-gpm flow control valve
C — Bypass tee
D — Pressure gauge (0-60 psi)
E — "All fine" carbon column
F — Constant-head tank
G — Metering pump
H — Volumetric measurement tank
I — Solenoid valve
J — Liquid level control relay
K — Disconnect switch
L — Convenience outlet
M — Digital counter

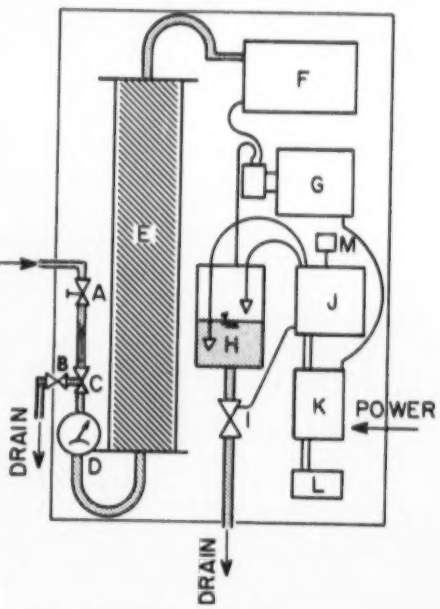


Figure 3B. Schematic, Model LF-2 organics sampler.

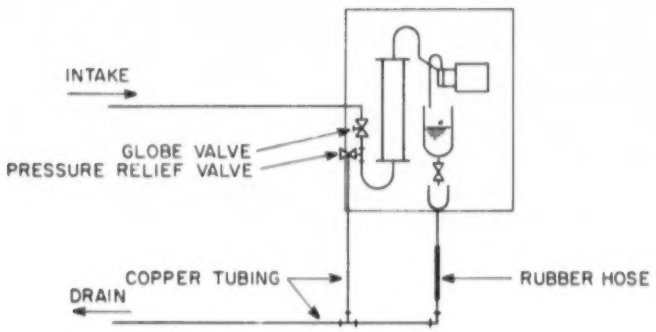


Figure 4A. Schematic, water plant installation.

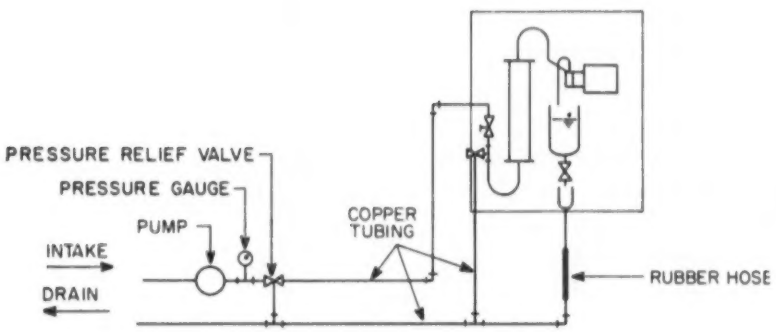


Figure 4B. Schematic, field installation.

possible sample of material from a given volume of water, *it is important to avoid contamination of the carbon from other organic sources.* Hence, the following precautions should be observed:

1. Ordinary organic pipe jointing compounds should *not* be used. Teflon tape or red lead (lead oxide) mixed to a paste with water can be used for this purpose.

2. *Plastic* hose is to be avoided; and if rubber hose is used in any connections, it should be flushed thoroughly before being being connected to the CAC. Copper tubing is ideal for connections. *NOTE:* Polyethylene pipe and PVC (polyvinyl chloride) pipe meeting National Sanitation Foundation (NSF) standards for drinking water are acceptable.

Both Models LF-1 and LF-2 must be installed rigidly in a vertical position. A location free from outside vibrations is necessary if the volumetric measuring system is to operate most accurately. Vibration of the equipment panel caused by the metering pump and solenoid valve may be nearly eliminated by proper mounting. Bolts or screws are recommended for installation of panels against wooden walls, and bolts and lead "tamp-ins" should be used when the panel is to be mounted against a masonry wall.

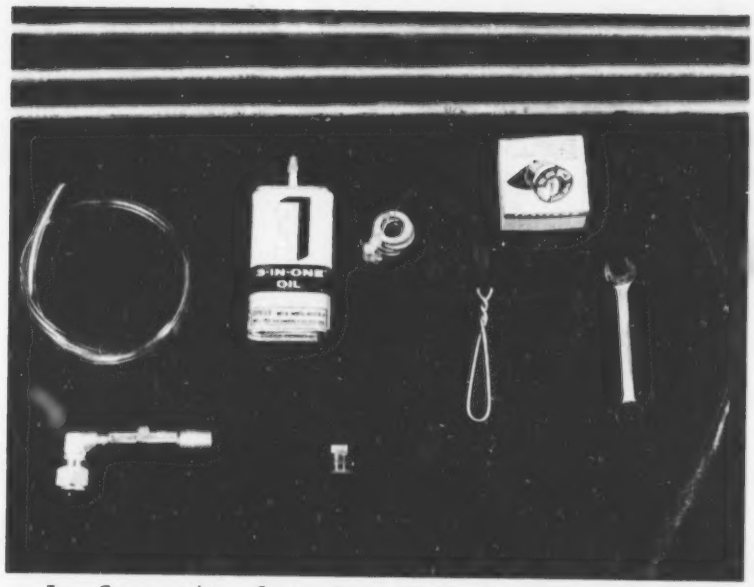
When the panel is securely in place, the metal straps across the ends of the carbon column should be removed and discarded, and the nuts securing the carbon column support blocks should be replaced.

Next, the cup drain should be secured in the tubing support clamp immediately below the solenoid valve and the 12-inch section of 3/8-inch - ID rubber hose clamped in position on the copper tube projecting from the cup drain. The lower end of this rubber hose should be connected to a drain line, but should not be clamped in position.

The water supply may now be connected to the compression-type fitting in the globe valve. Copper tubing (1/2-in. OD) should be used for this purpose.

When a Model LF-1 unit is being installed, a section of copper tubing is inserted into the fitting in the pressure relief valve and the other end is connected to the drain line. If, however, the unit is a Model LF-2, either the 3/8-inch pipe plug or the 1-gpm flow control assembly is inserted in the 3/8-inch tee immediately below the globe valve. This will depend upon the availability of a fresh water sample and a supply of at least 1 gpm. If the flow control assembly is used with Model LF-2, the discharge side of the assembly should be connected to the drain line by means of copper tubing.

Each unit has several spare parts including copper tubing, 1 foot of 3/8-inch-ID hose, and fuses. The spare parts boxed with Model LF-2 units are shown in Figure 5; those included with Model LF-1 units do not have the pipe plug or flow control assembly.



Top: Copper tubing; Center: Pump tubing, oil, washers, fuses, spanner wrench, 7/16-inch open-end wrench, hose; Bottom: Flow control assembly, pipe plug.

Figure 5. Spare parts included with organics sampling units.

The final step of the installation procedure is to make electrical connections for 115-volt, single-phase, 60-cycle operation. To do this, knock out one of the holes near the upper right-hand corner of the disconnect switch and introduce a three-wire cable. Connect the "hot" line (black) to the terminal nearest the "knockout" hole. The neutral wire (white) is connected to the terminal between the switches, and the ground wire (green) is connected to the screw that fastens the switch box to the equipment panel.

CALIBRATION

Before the organics sampler may be put into effective operation, the volumetric measuring system must be calibrated. The electrodes of the liquid level control system are cut so that incremental volumes of about 1 liter are measured for each count on the digital counter; however, the systems have not been checked individually and may be off as much as 10 percent.

To calibrate the volumetric measuring system, the following procedure should be used:

1. Throw the electrical switch to "on" to start the metering pump and supply power to the liquid level control system.
2. Open the globe valve in the water supply system. *This must be done slowly with Model LF-2 until the constant-head tank has reached its "full" level.* When the valve of Model LF-1 is opened, the water will rise in the carbon column very slowly and will take 6 or 7 minutes to fill the column. *There is no need to bypass carbon "fines" if care is taken not to open the supply line valve rapidly.*
3. The metering pump will begin to pump water into the volumetric measuring tank. Disconnect the lower end of the rubber hose from the drain line and direct it into a 1,000-milliliter graduated cylinder.
4. When the first incremental volume is discharged into the graduated cylinder, check the volume. If the volume is within 10 milliliters of 1,000 milliliters, the counter will give a reading in liters within 1 percent, which is acceptable. If, however, the volume is off by more than 10 milliliters, the electrodes should be adjusted to correct this error.
5. Volume error should be corrected as follows: Using the 7/16-inch open-end wrench included with the spare parts, loosen the bolt that holds the low-level electrode in position as shown in Figure 6. (The low-level electrode holder is marked "L" and is on the left side of the bracket.) If the volume measured was too small, lower the electrode slightly. Raise the low-level electrode if the volume was too large.

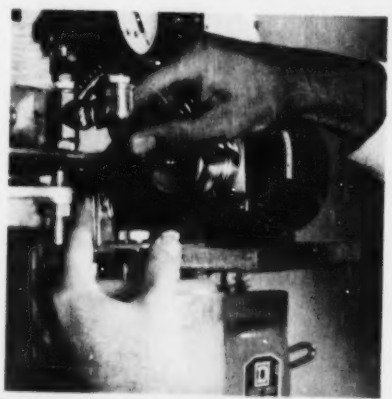


Figure 6. Adjusting low-level electrode.

6. After each adjustment, wait until two volumes have been measured by use of the graduated cylinder. If the average of the readings is still more than 10 milliliters off, repeat the adjustment until an acceptable volume is reached.
7. Be sure to tighten the bolt holding the electrode securely before the sampler is allowed to operate unattended.

OPERATION

Under most conditions, Models LF-1 and LF-2 operate properly without attention during a 1-week sampling period. This description of the operating procedure, however, is offered in order that the best results may be obtained from operation of the equipment.

The carbon column is installed in the sampler by first connecting the hose coupling on the Teflon hose to one end of the carbon column and then connecting the other hose. These connections should be *hand tightened only*. The column should be fastened in position with the web strap.

Before the sampling run is started, the metering pump should be lubricated and the pump tubing inspected for soundness.

To lubricate the pump, remove the small screw in the top of the green motor housing and allow several drops of oil to flow into the packing. Replace the screw in its original position.

Soundness of the metering pump tubing may be determined by removing the tubing from the pump and checking it visually. In addition, the presence of leaks may be discovered by removing the tubing from the Swagelok fitting and attempting to blow air through the tube after closing one end. Worn tubing should be replaced. A description of the use of Swagelok fittings will be found in a later paragraph.

To start operation, the power supply switch is thrown to the "on" position. Next, the globe valve in the water supply line is opened slowly until the volumetric measuring tank begins to fill. *It is important to open this valve slowly. As soon as the constant-head tank of the Model LF-2 has reached its "full" level, the valve should be opened completely.* The pressure relief valve of the Model LF-1 should be adjusted so that the pressure gauge nearest the metering pump reads 5 psi after the volumetric measuring tank has begun to fill.

It is well to check the calibration of the volumetric measuring system once during each run. Adjustment, which is seldom necessary, is accomplished as described earlier.

If leaks occur at the ends of the carbon column, they may be stopped by tightening the hose coupling *by hand*. Leaks at connections of copper tubing may be stopped by tightening the brass nut with an adjustable wrench.

Malfunction of the volumetric measuring system is rare when the panel is properly mounted; however, vibration of the equipment panel due to pumping action or solenoid valve operation could loosen electrical contacts and cause a malfunction. If the volumetric measuring system is observed to function improperly, the first step in trouble-

shooting is to check and secure electrical contacts at the electrodes and in the liquid level control. This will correct the difficulty in most cases. If the trouble persists, it may be caused by a poorly adjusted "throw" of the relay in the liquid level control. To correct a problem of this nature, an offset screwdriver is used to tighten the "stop" regulating the "throw" of the relay contacts. In Figure 7, the operator is showing the relay rack and "stop."

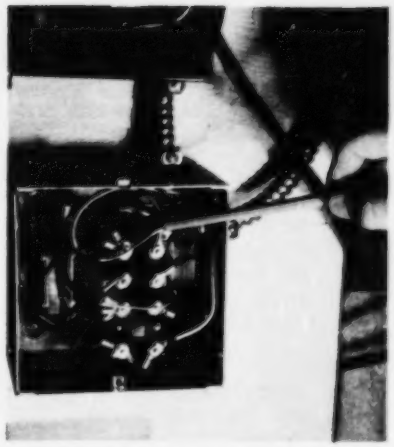


Figure 7. Liquid level control relay.

Since presettling of raw river water is not generally used with low-flow-rate sampling procedures, the carbon column may become plugged with silt and other suspended material filtered from the water. Maintaining flow through the carbon column in this situation may be accomplished by removing the column from the sampler, turning it "end-for-end," and replacing it in the system. If this procedure fails, mark the log sheet and return the column to the laboratory for processing.

When the sampler is to be idle for long periods of time, the volumetric measuring tank should be drained to prevent growth of algae. This is easily accomplished by removing the cover of the liquid level control and holding the relay closed with a pencil until the tank has been drained. (The power must be "on" during this operation.) The constant-head tank of Model LF-2 should also be drained by siphoning or with a sponge during idle periods of the sampler.

The tubing used with the metering pump is very wear-resistant and normally is replaced only after several sampling runs.

To remove the old tubing from the pump, use the following procedure:

1. Shut off the water supply, and drain the constant-head tank of Model LF-2.
2. Loosen, but do not remove, the nut of the Swagelok tubing fittings, and pull the end of the tubing from the fittings. Remove the brass inserts from the ends of the tube.

3. Hold the shaft of the pump with the spanner wrench as shown in Figure 8, and turn the knurled knob on the front of the pump in a counterclockwise direction until the tubing can be removed easily.
4. Place the brass inserts in a new section of tubing and place the new tube in the pump as shown in Figure 9. Be certain that the knurled knob on the front of the pump is tightened securely.
5. Push the end of the tube projecting from the side of the pump marked "outlet" into the fitting near the volumetric measuring tank, and tighten the Swagelok nut *by hand.* Removing the nut and ferrules from the fitting may not be necessary. If they had not been tightened too much, the ferrules and inserts may be reused.
6. Push the other end of the tube into the Swagelok fitting "upstream" and tighten it *by hand.*

Figure 10 shows a tube with its insert ready to be connected into the Swagelok connector.

Mechanical failure of the organics sampling system could be for any of a number of reasons. Following is a suggested procedure for checking and correcting system malfunction. (Only the case of a field installation will be discussed since this would be the more general situation):

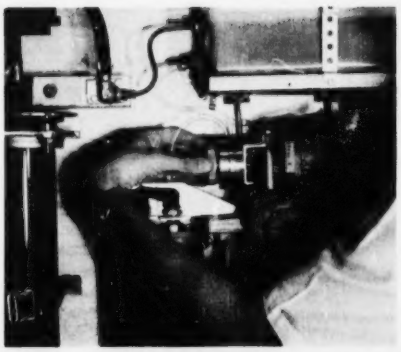


Figure 8. Changing pump tubing on Model LF-2.

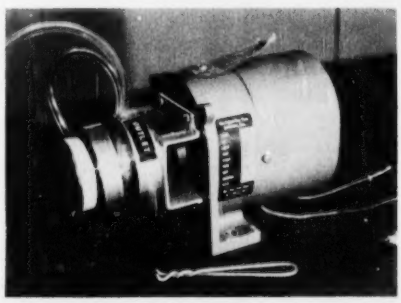


Figure 9. Pump after new tube has been inserted.

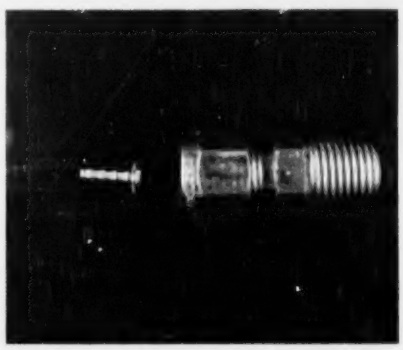


Figure 10. Tube with insert ready to be connected into Swagelok connector.

1. Check to assure that the intake and foot valve on the intake line are open and operating properly.
2. Check the electric supply.
3. Be sure that all joints in the intake line are air-tight.
4. Check pump prime.
5. Check pump rotor and stator for wear.
6. Check flow control orifice for possible plugging.
7. Check carbon column for plugging.
8. Check float valve on Model LF-2 for plugging.
9. Check metering pump tubing for leaks or plugging.
10. Difficulty stemming from the metering pump will be characterized by either very high or very low sampling rates and volumes. A determination of the nature of the difficulty will aid in its quick repair.
    a. If the electric motor operates properly, the pump "head" is faulty. (Remove faulty pump head with four screws on face of motor.)
    b. If motor is faulty, remove entire pump assembly.
    c. Return faulty parts to Cincinnati for replacement.

USE OF CARBON COLUMN DATA SHEET

Since the aim is to approach an accurate evaluation of the concentration of organics in the water, accurate data are important.

In preparing the data sheet shown in Figure 11:

1. Fill in all of the pertinent data at the top of the sheet, i.e., state, station location, type of sample, collected by.
2. Insert the date the filter run was started.
3. On the first line of the table, again enter the date of starting and the digital counter reading.
4. Whenever possible, record date, time, and meter reading throughout the sampling period.
5. When sampling run is stopped, make the last entry of the date and counter reading in the table. Enter the final date again opposite "stopped."
6. Subtract the initial counter reading from the final reading, and enter the difference opposite "liters."
7. Any pertinent observation related to difficulties with the equipment (weather problems, etc.) may be entered under "Comments."

8. Place the white (top) copy of the data sheet in the box with the carbon column for return to the Water Quality Section. The pink copy is retained by the cooperating agency.
9. Upon receipt of the used CAC in Cincinnati, a new column will be returned to the station for the next run.

SHIPPING

When the sampling run is completed, disconnect the AAC and drain off the excess water. Cap both ends of the column with the small metal caps. Place the carbon column and data sheet in the shipping box, and close the box securely with the straps provided. Affix the address label to the top of the box. No shipping charges are required when using the provided labels.

U. S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
DIVISION OF POLLUTION SURVEILLANCE
1014 BROADWAY CINCINNATI, OHIO 45202

CARBON ADSORPTION SAMPLE

	STATION NUMBER	STATION LOCATION	STREAM
OHIO	90	CINCINNATI	L. MIAMI

FEDERAL WATER POLLUTION CONTROL ADMINISTRATION

			TOTAL VOLUME SAMPLED
STARTED	DEC 4, 1967	0900	
STOPPED	DEC. 11, 1967	0900	1200

DATE	READING	REMARKS	DATE	READING	REMARKS
12/4/67	01022	START AT 0900			
12/5/67	01193	O.K. AT 0900			
12/7/67	01535	REPLACED TUBING AT 0900			
12/8/67	01791	O.K. AT 2100			
12/11/67	02222	STOP AT 0900			

PLEASE SEND ANOTHER SECTION OF PUMP TUBING.

DISTRIBUTION White Copy to Address Above, Pink Copy for Retention by Collecting Laboratory or Agency.
FWPCA 70-11-447
WATER QUALITY BASIC DATA REPORT (CARBON FILTER)

Figure 11. Data sheet.